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Optimizing Dental Waste Practices: A Comprehensive Review of Hospitals and Dental Clinics in Pakistan

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ABSTRACT

Objective: To analyze and document the management of biomedical waste, assessing potential health and environmental risks, over a period of six months throughout the dental hospitals of Pakistan.

Methodology: In this cross-sectional questionnaire-based study, the questionnaire was distributed to final-year students, house officers, postgraduate trainees, practicing dentists, and dental assistants in both private and public healthcare settings across Pakistan through electronic media. A convenient sampling technique was used and the study was completed in six months from April to September 2023, with a sample size of 356, actively practicing dental professionals, students, trainees, and dental assistants with a minimum of 6 months of experience included in this study. Non-practicing dentists and assistants within the last 6 months were excluded from the study the study assessed criteria and dental practitioners' knowledge regarding waste disposal in dental setups and hospitals.

Result: In biomedical waste disposal practices across hospitals and clinics, incorrect methods were observed in amalgam disposal (77.2% vs 75.8%), fixer disposal (92.2% vs 87.1%), bloody gauze disposal (52.1% vs 68.5%), tooth disposal (73.2% vs 60.4%), sharps disposal (75.1%, vs 29.4%), and solid waste disposal (24.8% vs 24.4%) in hospitals and clinics respectively. Proper methods, such as separators, silver recovery, yellow bags, and incineration, were variably used/adopted.

Conclusion: According to the current study, most private dental facilities and hospitals are unaware of the various types of biomedical waste and do not use proper disposal methods. There is an immediate need for practitioners to receive ongoing dental education on waste management in dental care.

Keywords: Awareness**,** dental waste, mercury waste management,

Authors' Contribution:
[1,2]Conception; Literature research; manuscript design and drafting; [3,4] Critical analysis and manuscript review; [5,6] Data analysis; Manuscript Editing.

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Introduction

Biomedical waste management is a fundamental issue in the healthcare system. If generated waste is not discarded properly it can be dangerous to human health as well as the environment. Like any health care system dental setup consists of much stuff for dental care delivery and it must be discarded appropriately.[1]

In recent years, with awareness of dental health and an increase in the dental care delivery system, more dental setups have developed. With the wide spread of this demand biomedical waste being generated is highly affecting human health and the

environment.[2] The incidence of many infections and pollution has increased playing its part in producing various kinds of new diseases.[3]

In nations such as Pakistan, there is a practice of reusing equipment and medical instruments.[4] Additionally, there exists a legal mandate to ensure the safety of both patients and medical practitioners[5,6] and it is the primary responsibility of every hospital management or clinic generating biomedical waste personnel to manage every kind of waste without creating adverse effects on human health.[7]

Many materials have been introduced in dentistry with each advancing day including impression materials, mercury, and restorative materials. These materials may be hazardous to the environment and health if they are not handled accurately. [3] Other hazardous dental waste includes X-ray fixers and films, chemical disinfectants, dental amalgam, sharps, scalpels, burs, orthodontic wires, blood-soaked dressings, silver, lead, and various solvents.[8] There should be proper segregation and identification of dental waste before disposing of it. This is how public health is not affected by these hazardous materials.[9] Dental waste consists of three main types: Infectious waste: which contains materials contaminated with blood or other infectious fluid of the mouth, sharps, and amalgam, non-infectious waste and domestic-type waste, non-infectious wastes consist of different solutions used in dental clinic which include disinfectants, x-ray liquid, hypochlorite and random waste in dental setup.[10] As described earlier dental healthcare setups generate both infectious and hazardous waste so everybody in a healthcare setup should be well-oriented and trained to manage healthcare wastes technically.[11]

There are broad waste management systems in developed countries however, developing countries are lacking in managing this kind of comprehensive waste management systems.[12] This suffering of developing countries is due to insufficient financial resources, and lack of awareness of research and accountability.[13] Dental setups produce hazardous waste products which are discharged into water systems disturbing human health as well as the whole ecosystem. Similarly, solid wastes produced by dental clinics are mixed up with household disposal. Although it should be recycled and separated before being dumped into landfills.[14] At present, very limited studies have been conducted to investigate and spread awareness for the management of dental waste in Pakistan. So, this study considered the importance of handling dental setup waste on a daily or weekly basis.

Methodology

It was a cross-sectional questionnaire-based study. The questionnaire was designed primarily and then it was distributed to final-year students, house officers, postgraduate trainees, working dentists, and dental assistants in private and public hospitals/clinics. A validated questionnaire was used to evaluate the criteria being practiced and knowledge about dental setup waste disposal among dental practitioners.

The research was conducted at all reachable dental practices all over Pakistan including Islamabad, Lahore, Karachi, and Multan via electronic media (Google Forms) from April to September 2023. A convenient sampling technique was used for this study. The study was completed in 6 months with a sample size of 356. All participants were informed of their voluntary participation, data protection, and the option of opting out at any time. The size of the sample was calculated by the online calculator raosoft, based on an expected prevalence of 30% and 95% Confidence interval (CI), and z value of 1.96 level.[15] Inclusion criteria were comprised of all currently working at least 6 months dental practitioners, students, trainees, and dental assistants. However, non-practicing dentists and assistants from the last 6 months were excluded.

Table 1: Demographic data of study participants and hospital/clinic waste management team

Variables		Hospital %	Clinic %
Designation	Dental Student	22 (9.4)	-
	House Officer	45 (19.4)	3 (2.4)
	PG Trainee	132 (56.9)	85 (68.5)
	Specialist	33 (14.6)	36 (29.1)
Experience	1-5 years	170 (73.2)	77 (62.1)
	6-10 years	45 (19.4)	36 (29.0)
	11-15 years	11 (4.74)	4 (3.2)
	>15 years	6 (2.5)	7 (5.6)
Responsible for Disposal	Assistant	103 (44.4)	76 (61.2)
	Janitor	96 (41.3)	34 (27.4)
	Other	33 (14.2)	14 (11.2)

from the study. SPSS software (version 20) was used to evaluate the data. Frequency and percentages were calculated and mentioned for each variable. P-value < 0.05 was considered statistically significant for logistic regression.

Results

The data was collected from 232 dental health professionals from (65.1%) hospitals and 124 (34.9%) from dental clinics. Among 356 study participants, the majority were post-graduate trainees 217(60.6%), 22 (6.18%) were dental students, 48 (13.4%) were house officers, and 69 (19.3%) were consultants or specialists. Out of 356 participants, 247 (69.3%) had been practicing for less than 5 years, 81 (22.7%) from 6-10 years, 15 (4.2%) from 11-15 years, and 13 (3.6%) for more than 15 years. More than half of the participants 179 (50.2%) reported that the dental assistants were responsible for waste management, 130 (36.5%) reported that janitorial staff was responsible for waste management and 47 (13.2%) reported that waste materials were handled by other staff.

Table 2 focuses on the disposal methods of different waste materials, for example, amalgam, fixer, bloody gauze, tooth, sharps, and solid waste,
in hospitals and clinics. It compares the practices between the two settings based on specific criteria. In the "Amalgam" category, the data indicates that 77.2% of hospitals and 75.8% of clinics employ the "Wrong" disposal method. On the other hand, 22.8% of hospitals and 24.1% of clinics use the "Separator" method. clinical settings showed that hospitals, in contrast to clinics, exhibit 0.50 times lower odds of utilizing yellow bags for the disposal of bloody gauze. This finding holds particular statistical significance, as the associated p-value is recorded at a noteworthy 0.003. This suggests a marked difference in the disposal practices between hospitals and clinics, with the odds favouring the latter. This indicates a significantly elevated risk in clinics with a p-value of 0.003. For tooth disposal, it was found that in the hospital setting, the odds of incorrect disposal were 100 times higher compared to clinics, with an odds ratio of 82.26 and a 95% confidence interval (CI) of 1 to infinity. This indicates a significantly elevated risk in hospitals with a p-value of 0.001.

Within the hospital environment, there was an incidence rate of 75.1% for incorrect sharps disposal, resulting in a substantial odds ratio of 29.4. This indicates a significant difference in sharps handling practices when compared to clinics. Additionally, a 95% confidence interval (CI) spanning from 0.38 to 0.97 is observed, underscoring the variation in practices between these healthcare facilities, with a p-value of 0.04, signifying statistical significance.

Table 2: Dental waste management in hospitals and clinics as determined by logistic regression analyse

Waste material	Method of disposal	Hospital (%)	Clinics %	Odds	CI	p-value
Amalgam disposal	Wrong	77.2%	75.8%	1.07	0.64-1.79	0.29
	Separator	22.8%	24.1%			
Fixer disposal	Wrong	92.2%	87.1%	1.76	0.86-3.58	0.11
	Silver recovery	7.7%	12.9%			
Bloody gauze disposal	Wrong	52.1%	68.5%	0.50	0.31-0.79	**0.003***
	Yellow bag	47.8%	31.4%			
Tooth disposal	Wrong	73.2%	60.4%	2.2	1.40-3.55	**0.001***
	Yellow bag	26.7%	21.7%			
	Incineration	-	17.7%			
Sharps disposal	Wrong	75.1%	29.4%	0.61	0.38-0.97	**0.04***
	Incineration	24.9%	70.5%			
Solid waste disposal	Wrong	24.8%	24.4%	0.78	0.47-1.29	0.3
	Municipal health collection	75.2%	75.5%			

Discussion

Using a well-organized layout is essential to ensure the correct handling and disposal of different waste materials produced during dental procedures, including amalgam, bloody gauze, and other potentially hazardous substances in dental clinics and hospitals. As part of an efficient dental waste management system, this entails defining protocols for amalgam, fixer, bloody gauze, teeth, sharps disposal, instrument sterilization, and appropriate disposal of dental waste. Infectious waste should be separated and incinerated or autoclaved in yellow leak-proof plastic bags. Infectious waste that has been neutralized can then be disposed of in landfills. Sharps should be collected in puncture-resistant containers (safety boxes) and incinerated or autoclaved before being disposed of in landfills.[2]In the current investigation, it was observed that a significant proportion of the hospitals (77.2%) and dental clinics (75.8%) involved were employing incorrect methods for the disposal of amalgam.

Findings from a study conducted in Morocco indicated that 68% of dental hospitals and clinics did not utilize amalgam separators for the appropriate disposal of amalgam waste.[16] Likewise, a study carried out in Pakistan disclosed that 65.4% of dentists were not appropriately disposing of amalgam waste.[17] These findings highlight a widespread failure in proper amalgam waste disposal across hospitals and dental clinics, indicating a concerning global issue.

In the current investigation, it was found that the majority of hospitals (92.3%) and dental clinics (87.1%) were not appropriately disposing of fixer solutions. A study conducted in India revealed that only 42% of dental clinics dispose of fixer solutions properly.[18] Another study in India reported that 51% of dentists were unaware of the proper disposal methods for fixer solutions.[19] This indicates a systemic failure in adhering to proper disposal protocols for fixer disposal within healthcare facilities, suggesting an urgent need for improved waste management practices worldwide.

In the present study, it was observed that approximately 52.1% of hospitals and 68.5% of dental clinics employ incorrect methods for disposing of bloody gauze. A study conducted in Nigeria revealed that 43.2% of dentists did not provide adequate instructions on the proper disposal of bloody gauze .[20] Similarly, another study in India indicated that only 38.5% of hospitals and dental clinics implemented the correct method for the disposal of bloody gauze.[21] These findings suggests widespread deficiencies in proper disposal methods for bloody gauze in healthcare facilities, indicating a systemic failure to adhere to essential safety protocols, which could pose significant risks to public health and hygiene. The current study showed that only 26.7% of hospitals and 39.4% of dental clinics used proper yellow bags and incineration for extracted tooth disposal. A study conducted in India revealed that 53% of dental clinics used yellow bags for the disposal of extracted teeth.[22] Similarly, another study conducted in India reported that 27% of respondents discarded extracted teeth by the wrong method. This indicates a concerning lack of adherence to proper disposal protocols for extracted teeth in healthcare settings, reflecting a broader issue of inadequate waste management practices, particularly in dental clinics, with potential implications for public health and environmental safety.

The findings of the current study revealed that a significant portion, 75.1% of hospitals, and 29.4% of dental clinics, employed improper methods for sharp disposal. In line with these results, a study in Ghana indicated that 89% of respondents disposed of sharps into general trash.[23] Likewise another study conducted in India found that 62% disposed of sharps into general trash and municipal corporation bins.[24] These findings highlight widespread shortcomings in proper sharp disposal procedures in both hospitals and dental clinics, indicating a systemic failure to adhere to essential safety protocols, which could pose significant risks to public health.

Current study results showed that the majority of dental clinics (75.2%) and hospitals (75.5%) disposed of solid waste properly via municipal health collection. Similarly, a study conducted in South Korea reported that the majority of public sector hospitals dispose of solid waste properly while only 18.1% of private clinics dispose of solid waste properly.[25] Another study conducted in Libya revealed that 82.1% % of professionals from private dental clinics confirmed the absence of a dedicated collection system for solid waste from health services.[26] This suggests a significant disparity in proper solid waste disposal practices between public sector hospitals and private clinics, highlighting potential shortcomings in waste management infrastructure and regulations within the healthcare sector.

In the present study, a high percentage of infectious and sharp waste was improperly disposed of in participating dental hospitals and clinics. However, the vast majority of them disposed of their solid waste in conventional ways.

Conclusion

The study reveals that many dental practitioners lack awareness about biomedical waste and proper disposal methods. Urgent, continuous dental education is needed. Biomedical waste poses a significant challenge in healthcare institutions, threatening health and the environment. Thorough waste audits are crucial for precise data, and adherence to protocols, guidelines, and innovative technologies can enhance waste management.

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